IW-00130

Military Operations
BATTLEFIELD VISUALIZATION CONCEPT

Summary. This concept serves as the basis for focusing those technological and nontechnological **initiatives** which support the commander's **ability** to visualize the future battlefield. It provides the **framework** to **describe battlefield** visualization and required capabilities prescribed for a force projection Army.

Applicability. The concept applies to all **TRADOC** activities which develop doctrine, training, leader development. organizations, materiel, and soldier (DTLOMS) requirements.

Contents

The ability to move information rapidly and process it will likely change the way we command military operations. It will greatly influence force organization, command procedures, and staff systems. Maneuver, combat support, and combat service support leaders, horiwntally linked by common information, will, for the first time, have a means to visualize how they will execute in harmony, integrated by a shared vision of the battlespace. Individual soldiers will be empowered for independent action because of enhanced situational awareness, digital control, and a common view of what needs to be done."

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Chapter 1
Introduction

l-l. Purpose. This operational concept describes command of combat forces in battle and operations other than war (OOTW). It serves as the conceptual underpinning for work in battlefield visualization—a critical component of battle command The concept articulates the **fundamentals** of **battlefield visualization** to facilitate future research, experimentation, and training efforts in this area These efforts will be integrated to provide the commander with the doctrinal, training, organizational, leadership, materiel; and soldier means to clearly see and understand the battle from initiation through **the successful achievement** of the desired end state. The concept places special emphasis on the role of the commander. while integrating information-age technology to provide commanders with a comprehensive view of the battlefield-a view which reduces uncertainty, minimizes risk, promotes clear and rapid transmission of intent and orders, and facilitates the decisive employment of combat power. This concept has implications for all commanders, but is especially applicable to brigade and higher level command.

1-2. References.

a. *FM 100-5, Operations.*

b. FM 100-6, *Information Operations* (TBP).

c. TRADOC Pam 525-5, *Force XXI Operations.*

d. TRADOC Pam 525-69, *Concept for Information Operations.*

e. TRADOC Pam 525-200-l. *Battle Command Battle Dynamic Concept.*

f. TRADOC Vision of Future Battle, 23 Sep 93.

1-3. Explanation of term.

Battlefield visualization
The process whereby the commander develops a clear understanding of the current state with relation **to the** enemy and environment, envisions a desired end state which represents mission accomplishment, and then subsequently visualizes the sequence of activity that moves the commander's force from its current state to the end state.

Chapter 2
Overview

2-1. Introduction.

a. Command of soldiers and units in battle places great demands on the commander as a leader and decision maker. To make effective decisions, commanders must formulate and articulate a vision of their unit conducting an operation against an opposing force over time. This vision begins with the current situation on the battlefield and goes through the desired conclusion to the operation.

b. Formulation of the battlefield vision by the commander is a difficult and complex task Information obtained by human and technological means is **analyzed** and processed by the staff to provide the commander only that information needed to make decisions. This information is then blended with the commander's knowledge, experience, and intuitive feel for the battlefield to create the commander's battlefield vision.

2-2. Future battlefield.

a. Future operations will span war and OOTW. The increasing complexities of joint, multinational, and interagency operations place unparalleled demands on commanders. Technology, which provides an abundance of real-time information in one situation, must be adapted to meet more ambiguous, less certain threat situations. Sensors which work in one environment may be ineffective in another. The integration of human intelligence remains important to visualize the battlefield.

b. For the commander, knowing if, when, and' what to decide is a sophisticatedart. Decision brings with it the cost of committing resources. foreclosing options, incurring risks, and revealing intentions to the enemy. Uncertainty and chance will continue to bedevil decision making.

c. The successful future commander must possess an intuitive feel for combat developed through repetitive training, experience, and exposure to experienced mentoring and leadership. This intuition is based on a timely and accurate view of the battlefield if the unit is to be successful in battle.

Chapter 3
Concept

3-1. Battle command.

a. Battle command is the art of battle decision making, leading, and motivating soldiers and their organizations into action to accomplish missions. It begins with the training a commander provides for the command and ends

with the successful redeployment and recovery of the command in preparation for its next operation.

b. Battle command consists of visualizing the current state and desired future end state for an operation and includes deciding how to get from one to the other at least cost to the soldier. This process has both an art and a science component which are integrated by the commander into a single, comprehensive battlefield vision.

c. Battlefield visualization lies at the center of battle command. It is the mental process which supports the commander's decision-making process. **Utilizing** a vision of the proposed battle allows the commander to know when, where, and if a decision should be made. It is a continuous process which commences prior to the operation and continues through achievement of the desired conclusion to the operation. Additionally, it provides the key to where and how the commander can best lead and motivate soldiers.

3-2. The art of battlefield visualization.

a. Battlefield visualization is an essential leadership attribute of the commander and is critical to accomplishing missions. It is learned and attained through training, practice. experience, wisdom, and available battle command technologies. Other resources, both human and technological, only serve to assist the commander in formulating a vision and taking action to implement it. To be successful in battle, the commander must apply experience and intuition to sort through the myriad of information available on the battlefield. Determining critical information requires focus on three aspects of the commander's vision.

(1) The first is understanding the current state of friendly and enemy forces. This knowledge extends beyond the physical location of forces, environmental factors, and combat readiness (equipment and supplies). It also includes human factors such as fatigue, morale, and the **decision**-making processes and information requirements of both forces.

(2) The second aspect of the commander's vision is the ability to clearly discern a desired end state. Initially, this involves foreseeing a feasible outcome **to the** operation which results in mission success and leaves the unit postured for the next mission.

(3) The third aspect of visualization is the ability to see and understand the dynamic relationship between the opposing forces as the commander leads forces through the sequence of activity from current situation to final end state. This includes envisioning possible enemy moves and

counters to those moves to defeat or destroy the enemy force. The commander decides when to shift the main effort. when to change priorities, when to reinforce, when to request additional forces, or when to disengage. During the execution of the mission, the commander continually assesses the envisioned end state to ensure that it is still desired and achievable.

b. Connectivity must exist between current **operations** and the future plan. While a portion of this future state **may** be dictated by a higher level commander's intent, the battle commander must personally envision the operation **from** start to finish.

c. The commander articulates a battlefield vision through an intent statement which guides the development of a concept for the operation and subsequent execution of the mission.

3-3. The science of battlefield visualization.
Visualization of the battlefield requires the use of operational tools which are derived **from** science and technology. However, technology alone cannot provide the commander with a full visualization of the **battlefield.** Technology must be used together with the commander's judgment, wisdom, experience, and intuitive sense to enhance the **visualization** of the battlefield Technology support should be focused in four areas: total mission awareness: mission planning, rehearsal, and execution: future technology requirements: and technology integration.

a. Total mission awareness. Situational awareness provides commanders at all echelons with **near real-time** information on the current situation. The picture is derived from data common to all echelons which can be tailored for resolution and content by the level of command applying **it.** Data bases must be exchanged, accessed, and shared among all appropriate agencies involved in the operation.

(1) Friendly forces.

(a) Every commander **must know the** disposition of their farces without having to visit each unit on the ground. Technology must provide information that can be displayed electronically, depicting the accurate location of critical systems and units on the battlefield These locations must be updated in the data base **frequently** enough to ensure an accurate and near real-time display of the **friendly** force's disposition. Additional information reported electronically by the unit provide the commander and staff detail concerning the status of the unit.

(b) The friendly situation is not limited to data elements in the situation report Technology, adjusted and tempered by the commander's judgment, helps

maintain awareness of subordinate units' state of readiness, to include the state of training, maintenance, and logistical status.

(2) Enemy forces. Technology must allow the commander to **visualize** the disposition of enemy forces. Enemy situational awareness comes from many sources including: space and aerial platforms, sensors, reports from units, other **human** intelligence, and information derived from computer-assisted intelligence analysis. **Visualization** of the enemy force must include an awareness of the enemy's speed of advance, tempo of operations, and known vulnerabilities. Technology must display the enemy force in the same digital frame of reference as the friendly forces.

(3) Noncombatants. Noncombatants are those individuals in the tactical area of interest who are not engaged in active hostilities. These individuals may include refugees, evacuees, prisoners of war, or members of nonmilitary organizations. Their presence, attitudes, physical activities, and requirements can have a significant effect on the outcome of the mission. Sustaining total mission awareness requires that noncombatants be considered in the commander's vision of the battlefield.

(4) Environment. Environmental conditions have a profound effect on military operations. Technologies must provide the battle commander information about the environment including geography, hydrology, weather, seasonal conditions, vegetation, illumination data, and particularly terrain. The commander must rapidly assess the immediate and lingering effects of environmental conditions. Environmental effects must be represented within the common relevant picture to ensure battle commanders consider their potentially dramatic effects during planning, rehearsal. and execution of operations.

(5) Terrain visualization. The commander requires the ability to see the battlefield on which their units and the enemy will deploy. maneuver, and fight. The resolution required at lower echelons may include the terrain slope and elevation, traffrcability, vegetation, and other natural and man-made features. Technology provides the battle commander the ability to see a portion of the **earth's surface.** While this vision may be seen from directly above, it may also be viewed from the oblique. Terrain visualization includes both **natural** and man-made features to include impacts of terrain on vehicle speed, maintenance, river-crossing operations, cross-country trafficability, and maneuverability. Terrain-visualization products assist the commander and staff during all phases of the operation. Terrain-visualization provides common terrain background for all users and all applications. Additionally, terrain visualization allows interactive planning and mission rehearsal. Terrain-visualization technology must reflect

real-time updates as features change due to the effects of combat and nature.

b. Mission planning, rehearsal. and execution. Technology must provide the tools to allow the commander to **visualize** and assess the sequence of actions from the current state to the desired end state. This must be an integrated system that assists the commander in optimizing mission planning, facilitates effective rehearsals, and monitors understanding of the commander's intent prior to and during execution of the mission. The same system must be used in training and combat. Software must operate in the live, virtual, and constructive simulation environments to approximate real combat. Technologies, which include simulations and artificial intelligence, allow commanders to duplicate the real world in an environment where risk is minimal. Mission planning, rehearsal, and execution systems are used in training, preparation for combat, and during actual combat to rapidly assess trends and suggest previously unexplored courses of action. The commander must, however. use these tools judiciously, applying common sense and experience rather than accepting the computer solution as the best solution.

(1) Planning. Technology is required to support mission planning. To effectively plan operations, the commander must understand the current state, the intent of senior commanders, and visualize the desired future state of the battlefield. To do this, the commander requires tools which facilitate that visualization.' Simulations, depicted on accurate terrain and displayed on computer displays in real-time, aid the commander's decision-making process. This enables the commander to visualize the battlefield; refine commander's intent; and develop, war game, and analyze the potential courses of action.

(2) Rehearsal. Technology in support of planning must also support rehearsals. The automated planning process provides products that assist the commander in graphically depicting the mission plan. Having communicated commander's intent and a decision on the best course of action. the commander, staff, and subordinate leaders use interactive simulation and animation technology to rehearse all aspects of the operation. Using distributed communications and computers, the rehearsal need not be conducted at a central location, but may be accomplished at local command posts.

(3) Execution. Technologies are needed to keep the commander informed as the operation unfolds. Once the battle has commenced, the commander receives real-time updates from subordinate units, guidance from the higher headquarters, and information on enemy action. This presents the commander and staff with alternatives for immediate consideration. further enabling the cognitive

process of battlefield visualization to evolve. Technology alerts the commander at predetermined decision points and provides information required **to** make the right decision. The commander must monitor real-time status of operations to ensure they are being conducted according to plan and commander's intent. The net effect is that the commander may rapidly and effectively alter the initial plan to adapt to changing situations precipitated by unexpected enemy action or changes in the status of the friendly **forces.**

c. Future technology requirements. As we move to the future, many technologies will emerge to help the battle commander **visualize** the **battlefield.** They will include everything **from** computing power to communication capabilities. To provide the commander with the requisite battlefield visualization tools as described above, the following must be developed and integrated into the Army Battle Command System (ABCS).

(1) Digital terrain. Digital **terrain** is the foundation technology that supports many of the battlefield visualization tools described above. Several technical approaches are available for collecting the data to support digital map products. Resources must be programmed to digitize terrain on which our forces train. Additionally, there must be a **resourced** capability to rapidly produce digital map products to support real-world missions. Digital terrain allows the computer to make calculations based on accurate terrain information and the user to zoom in on a given area without a significant loss of resolution.

(2) Display devices. Visualizing the disposition of friendly and enemy forces depicted on digitized terrain requires a variety of display devices, engineered to fit the user's operational environment, to include --

- Dismounted soldiers.
- Individual vehicles.
- Command posts at all echelons.

(3) Communications.

(a) Communication technology requirements must support the exchange of information, both voice and data. between commanders, between the commander and the commander's tactical operation centers, within command posts, and between command posts. Communications must be **seamless—the** connections among communications systems must not require an operator to transcribe a message from one system and transmit it over a second system. Technology must be engineered so that this **exchange** is transparent to the operator. Gateways may be a part of the communications system. or they may be computer terminals which route the information according to a set of rules or instructions.

(b) Current communications available on the battlefield are not sufficient to support voice, data, and video requirements on the future battlefield. New technologies that allow greater band width, higher data rates, and data compression must be developed to support the objective capability. These technologies must **integrate** all communication devices to minimize training and enhance ease of operation.

(4) Computers. Technology must offer computer systems that conform to size, weight, and power limitations found throughout the **battlefield.** Computers must be smaller, more rugged, faster, and more capable to support lower tactical echelons. Computers must be compatible with the following hardware, software, and information requirements.

(a) The Army Common Operating Environment defines the standards to which computer hardware and operating systems must conform.

(b) The ABCS provides a family of applications (software and data bases) which allows proponents to plan and execute combat operations.

(c) Computers must utilize static information such as terrain data and ballistic **firing** tables.

(d) Computers must maintain dynamic information such as unit locations and supply status.

(e) Computers must access virtual information from remote data without operator intervention.

(5) Networks. Technology must ensure that the force is effectively internetted. Development of gateways and other technologies must ensure fast, effective information exchange for the battle commander.

d. Technology integration. The total impact of technology is realized when **all** automated systems have the capability to exchange information with each other in a manner transparent to the operators. The **application of artificial** intelligence and the common operating environment provides an open systems **architecture** that allows the broad exchange of information with the timeliness needed to decisively influence combat operations. Emerging technology will give battle commanders and their staffs capabilities to **visualize** the future battlefield.

3-4. Integration of battlefield visualization. The commander integrates information received from human and technological sources. Battlefield visualization is predominately a human endeavor-it is more art than

science. The commander is key to conceptualizing, planning, preparing, and executing operations-a responsibility which cannot be delegated.

a. Modem warfare is fast-paced and lethal. These characteristics promote uncertainty and risks. To rapidly ascertain the situation and make effective decisions, the commander forms a battle staff. They anticipate the outcome of current operations and assist the commander in developing the detailed concept for future operations. Battle staffs are organized to ensure the command process is sustained. The staff must understand what information the commander deems important for making decisions.

b. The commander and staff employ many technological assets to assist in analyzing and integrating the vast amount of information on the battlefield. These assets help to focus the commander's vision by increasing the accuracy and timeliness of information such as current friendly and enemy situations, logistical status, terrain and environmental factors. The battle staff assists the commander by collecting, assessing, analyzing, and discarding information not relevant to the operation. Technological means integrate and synchronize the vision through the real-time transmission of a common picture of the battlefield made relevant to the echelon of command receiving it.

c. In the final analysis. the commander validates the integrated battlefield vision. Technological means, while powerful in assessing a situation at a point in time, are less useful in predicting factors such as enemy intentions, friendly morale. and fatigue. The commander personally accounts for these factors as they directly impact the level of combat power obtained from the full combat potential of the unit. Reliance on the output of technological assets without applying human judgment can cause a seemingly effective course of action to be imprudent.

Chapter 4
Implications

4-l. Doctrine. Doctrine continues to place the responsibility for visualizing the battlefield and making decisions relating to the execution of the operation with the commander. As a result, doctrine emphasii the battlefield visualization process and the role of technology and the battle staff in supporting the process. Battlefield-visualization doctrine permeates down to the lowest level of command.

4-2. Training. Training in the information age must retain a sense of realism. The military education system needs to inculcate the battlefield visualization process at all stages of professional military education. Training, whether

conducting live or simulated exercises, should be repetitive utilizing the battlefield-visualization process to help attain the levels of mature judgment, experience, and intuition required of a battle commander. Additionally, training with the technological tools which help support the visualization process will be required

4-3. Leader development. Battlefield visualization is the cornerstone of battle command. Since battlefield vision emanates from the commander, the requirement for capable field commanders will be important to the Army of the twenty-firs century. Judgment, experience, and intuition are critical. The leader development system must drive the timely development of commanders capable of envisioning events, making decisions, and taking rapid actions on the future battlefield. This requirement must be supported by the professional education system and command selection and assignment criteria. length of duty assignments, and repetitive commands. Early identification of leaders who have the aptitude for command will be imperative.

4-4. Organizations. Various headquarters and battle staffs must be more fully integrated into the battle command system. The staffs will continue to hold a shared responsibility in supporting and participating in the commander's visualization effort by providing timely information, advice, and recommendations.

a. The staff's role shifts from preparing reports to synthesizing information in accordance with the priorities specified or implied in the commander's intent. This enables them to anticipate and facilitate future requirements.

b. Supporting battlefield technologies provide economies in time and personnel requirements. These technologies prompt the realignment of battle staffs and echelonment of the division and corps headquarters* command posts. Battle staffs and command posts will be smaller, more mobile and capable of conducting continuous operations. The commander Will be free to move about the battlefield to where operational needs can be most effectively met, yet have immediate access to the full range of information available in the tactical operations center.

c. Battlefield units will also be realigned. They will be smaller and more lethal. Digitizing weapon systems enhances existing hardware and gives the commander greater flexibility in organizing for combat. This allows the commander to more easily weight the effort to take advantage of opportunities that present themselves during the course of the battle.

4-5. Materiel. There is cogent need to focus available and future technologies that can assist the commander's

battlefield visualization process. As these technologies are brought on-line, **particular** emphasis will be placed on vertical and horizontal interconnectivity to ensure common views of the battlefield are presented in a relevant manner to commanders at **all** echelons.

4-6. Soldiers.

a. Battle commanders and their soldiers are empowered by knowing --

- **Where they are.**
- Where their adjacent, supporting, and supported elements are.
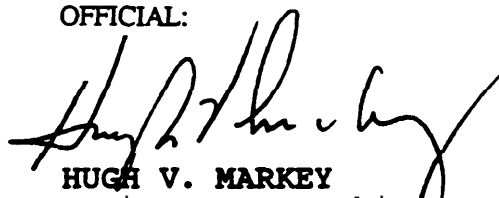- Where the enemy is.

Having a real-time picture of the battlefield allows soldiers to concentrate on the mission. By leveraging current and emerging technology to reduce the unknowns, the **Army**

enhances the skills and courage of the American soldier. Reducing the uncertainty in decision making at all levels means less risk to the soldier. Eliminating the **time**-consuming requirement to physically reconnoiter an area enables the commander to maintain or regain the initiative by immediately acting within a short window of **opportunity.**

b. Battlefield **visualization** requires that every soldier develop and maintain faith in the relevant common picture provided This can only be accomplished if each soldier is well trained and operating within the limits of assigned equipment. Every soldier **must,** through repetitious and effective **training,** come to trust the vision provided Additionally, each soldier must have a means to receive and fully understand the commander's intent derived from visualizing the battlefield. Soldiers must then act independently or collectively toward fulfilling the commander's vision.

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